IEEE 802.3 Greater than 10 Gb/s Automotive Ethernet Electrical PHYs Study Group
Report

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Teleconference

May 21, 2020

IEEE 802.3 Greater than 10 Gb/s Automotive Ethernet Electrical PHYs Study Group information

Study Group Organization

Steve Carlson, Chair

Natalie Wienckowski, Ad Hoc Chair

Jon Lewis, Recording Secretary

Study Group Charter

Move that the IEEE 802.3 Working Group request the formation of a Study Group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for Greater than 10 Gb/s Automotive Ethernet Electrical PHYs

Study Group web and reflector information

Send **Greater than 10 Gb/s Automotive Ethernet Electrical PHYs Study Group** reflector messages to:

stds-802-3-B10GAUTO @*listserv.ieee.org*

Study Group web page URL:

http://ieee802.org/3/B10GAUTO/index.html

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Pre-submitted documents – completed PAR, CSD, and OBJ

PAR: https://mentor.ieee.org/802-ec/dcn/20/ec-20-0008-01-00EC-ieee-p802-3cy-draft-par-response.pdf

CSD: https://mentor.ieee.org/802-ec/dcn/20/ec-20-0009-00-00EC-ieee-p802-3cy-draft-csd-response.pdf

OBJ: http://grouper.ieee.org/groups/802/3/B10GAUTO/B10GAUTO_OBJ_DRAFT_03_1119.pdf

All documents were pre-submitted on 15 February 2020

DRAFT Objectives

Preserve the IEEE 802.3/Ethernet frame format at the MAC client service interface

Preserve minimum and maximum frame size of the current IEEE 802.3 standard

Support full duplex operation only

Define optional startup procedure which enables the time from power_on=FALSE to a state capable of transmitting and receiving valid data to be less than 100ms

Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface (or the frame loss ratio equivalent)

Support a data rate of 25 Gb/s, 50 Gb/s and 100 Gb/s at the MAC/PLS service interface.

Support optional Auto-Negotiation

Support optional Energy Efficient Ethernet optimized for automotive applications

Support operation in automotive environments (e.g., EMC, temperature)

Do not preclude meeting FCC and CISPR EMC requirements.

DRAFT Objectives

Define the performance characteristics of an automotive link segment and an **electrical** PHY to support 25 Gb/s point-to-point operation over this link segment supporting up to 2 inline connectors for at least 11 m on at least one type of automotive cabling.

Define the performance characteristics of an automotive link segment and an **electrical** PHY to support 50 Gb/s point-to-point operation over this link segment supporting up to 2 inline connectors for at least 11 m on at least one type of automotive cabling.

Define the performance characteristics of an automotive link segment and an **electrical** PHY to support 100 Gb/s point-to-point operation over this link segment supporting up to 2 inline connectors for at least 11 m on at least one type of automotive cabling.

Support optional Clause 104 power over data lines on appropriate media.

WG Motion

Move that the IEEE 802.3 Working Group approve the IEEE P802.3cy objectives http://grouper.ieee.org/groups/802/3/B10GAUTO/B10GAUTO_OBJ_DRAFT_03_1119.pdf with modifications as detailed on slides 4 through 5 of 0520_B10GAUTO_report.pdf

M: Natalie Wienckowski

S: Hossein Sedarat

Y: N: A: (Technical ≥75%)

Passed with unanimous consent by the SG

P802.3cy PAR (changes)

P802.3cy

Submitter Email: david_law@ieee.org

Type of Project: Amendment to IEEE Standard 802.3-2018

Project Request Type: Initiation / Amendment

PAR Request Date: 14 Nov 2019

PAR Approval Date:

PAR Expiration Date:

PAR Status: Draft

Root Project: 802.3-2018

1.1 Project Number: P802.3cy

1.2 Type of Document: Standard

1.3 Life Cycle: Full Use

2.1 Project Title: Standard for Ethernet

Amendment: Physical Layer Specifications and Management Parameters for greater than 10 Gb/s

Electrical Automotive ~~Electrical~~ Ethernet

3.1 Working Group: Ethernet Working Group(C/LM/WG802.3)

3.1.1 Contact Information for Working Group Chair: Name: David Law

Email Address: david_law@ieee.org

P802.3cy PAR (changes)

3.1.2 Contact Information for Working Group Vice Chair:

Name: Adam Healey

Email Address: adam.healey@broadcom.com

3.2 Society and Committee: IEEE Computer Society/LAN/MAN Standards Committee(C/LM)

3.2.1 Contact Information for Standards Committee Chair:

Name: Paul Nikolich

Email Address: p.nikolich@ieee.org

3.2.2 Contact Information for Standards Committee Vice Chair:

Name: James Gilb

Email Address: gilb@ieee.org

3.2.3 Contact Information for Standards Representative:

Name: James Gilb

Email Address: gilb@ieee.org

4.1 Type of Ballot: Individual

4.2 Expected Date of submission of draft to the IEEE SA for Initial Standards Committee Ballot:
Mar 2023

4.3 Projected Completion Date for Submittal to RevCom:
Oct 2023

5.1 Approximate number of people expected to be actively involved in the development of this project: 50

P802.3cy PAR (changes)

5.2.a Scope of the complete standard: This standard defines Ethernet local area, access and metropolitan area networks. Ethernet is specified at selected speeds of operation; and uses a common media access control (MAC) specification and management information base (MIB). The Carrier Sense Multiple Access with Collision Detection (CSMA/CD) MAC protocol specifies shared medium (half duplex) operation, as well as full duplex operation. Speed specific Media Independent Interfaces (MIIs) provide an architectural and optional implementation interface to selected Physical Layer entities (PHY). The Physical Layer encodes frames for transmission and decodes received frames with the modulation specified for the speed of operation, transmission medium and supported link length. Other specified capabilities include: control and management protocols, and the provision of power over selected twisted pair PHY types.

5.2.b Scope of the project: Specify additions to and appropriate modifications of IEEE Std 802.3 to add greater than 10 Gb/s electrical Physical Layer specifications for symmetrical and asymmetrical operation and management parameters for media and operating conditions for applications in the automotive environment.

P802.3cy PAR (changes)

5.3 Is the completion of this standard contingent upon the completion of another standard? No

5.4 Purpose: This document will not include a purpose clause.

5.5 Need for the Project: Automotive in-vehicle networks have begun the transition from legacy electronic architectures (domain-based) to zonal architectures ~~(centralized architecture)~~ using Ethernet links to support fully autonomous operation. This has generated a need for data rates greater than 10 Gb/s in the automotive environment. IEEE Std 802.3 does not currently support rates greater than 10 Gb/s in the automotive environment.

5.6 Stakeholders for the Standard: End-users, automotive Original Equipment Manufacturers (car makers) and Tier x ~~1 and below (top-level and below)~~ automotive suppliers, system integrators, and providers of systems and components (e.g. 4K and 8K cameras, sensors, actuators, artificial intelligence (AI) processors, instruments, controllers, network infrastructure, user interfaces, and servers) for automotive applications.

P802.3cy PAR (changes)

6.1 Intellectual Property

6.1.1 Is the Standards Committee aware of any copyright permissions needed for this project?

No

6.1.2 Is the Standards Committee aware of possible registration activity related to this project?

No

7.1 Are there other standards or projects with a similar scope? No

7.2 Is it the intent to develop this document jointly with another organization? No

8.1 Additional Explanatory Notes : For 5.5: "Domain-based" architectures have many separate Electronic Control Units (ECU) and networks for each automotive subsystem, e.g. powertrain, information and entertainment (infotainment), body (lights, windows, doors, etc.). "Zonal" architecture consolidates many of these cross-domain ECU functions into a small number of supercomputer-level ECUs networked with greater than 10 Gb/s Ethernet.

For 5.6 -- Tier x refers to the various levels of suppliers to Original Equipment Manufacturers (e.g., car manufacturer). A Tier 1 supplier for example supplies components or subsystems directly to the OEM.

WG Motion

Move that the IEEE 802.3 Working Group approve the proposed IEEE P802.3cy Greater than 10 Gb/s Electrical Automotive Ethernet PHYs PAR https://mentor.ieee.org/802-ec/dcn/20/ec-20-0008-01-00EC-ieee-p802-3cy-draft-par-response.pdf with modifications as detailed on slides 7 through 11 of 0520_B10GAUTO_report.pdf.

M: Hossein Sedarat

S: George Zimmerman

Y: N: A: (Technical ≥75%)

Passed with unanimous consent by the SG

Managed Objects

Describe the plan for developing a definition of managed objects. The plan shall specify one of the following:
   a) The definitions will be part of this project.
   b) The definitions will be part of a different project and provide the plan for that project or anticipated future project.
   c) The definitions will not be developed and explain why such definitions are not needed.

The definition of protocol independent managed objects, to be included in Clause 30 of IEEE Std 802.3, will be part of this project.

Coexistence

A WG proposing a wireless project shall demonstrate coexistence through the preparation of a Coexistence Assurance (CA) document unless it is not applicable.
    a) **Will the WG create a CA document as part of the WG balloting process as described in Clause 13?**
    b) **If not, explain why the CA document is not applicable**

- A CA document is not applicable because the proposed project is not a wireless project.

Broad Market Potential

Each proposed IEEE 802 LMSC standard shall have broad market potential. At a minimum, address the following areas:
   a) **Broad sets of applicability.**
   b) **Multiple vendors and numerous users.**

Broad Sets of Applications:

Recent automotive electrical architecture changes, e.g. to zonal architectures, (zonal or central architecture) require automotive Ethernet rates in excess of 10 Gb/s.

High-performance cameras, CPU-to-CPU links, redundant links, sensor aggregation and data recorder systems require minimum data rates of 25 Gb/s.

Multiple vendors and numerous users:

At the Call for Interest, 73 individuals from 44 organizations indicated they would support this project. These included automotive OEMS, automotive Tier 1, silicon, infrastructure, cabling, connector, and test equipment vendors.

Data presented at the CFI indicate a substantial market potential, e.g., the prediction for 2025 is >100 million total automotive Ethernet ports/year.

Compatibility

Each proposed IEEE 802 LMSC standard should be in conformance with IEEE Std 802, IEEE 802.1AC, and IEEE 802.1Q. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with IEEE 802.1 WG prior to submitting a PAR to the Sponsor.

    a) Will the proposed standard comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?
    b) If the answer to a) is "no", supply the response from the IEEE 802.1 WG.
    c) Compatibility with IEEE Std 802.3
    d) Conformance with the IEEE Std 802.3 MAC

The proposed amendment will remain in conformance with IEEE Std 802, IEEE Std 802.1AC, and IEEE Std 802.1Q.

The proposed amendment will conform to the IEEE full-duplex 802.3 MAC and provide new physical layer specifications.

Distinct Identity

Each proposed IEEE 802 LMSC standard shall provide evidence of a distinct identity. Identify standards and standards projects with similar scopes and for each one describe why the proposed project is substantially different.

Substantially different from other IEEE 802.3 specifications / solutions.

There is no IEEE 802.3 standard that supports electrical Ethernet at rates greater than 10 Gb/s for the requirements of automotive applications.

The project may define multiple PHYs, but will define only a single PHY for each rate, media, and link reach combination.

Technical Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence that the project is technically feasible within the time frame of the project. At a minimum, address the following items to demonstrate technical feasibility:
   a) **Demonstrated system feasibility.**
   b) **Proven similar technology via testing, modeling, simulation, etc.**
   c) **Confidence in reliability.**

The proposed project will build on the array of Ethernet component and system design experience, and the broad knowledge base of Ethernet network operation.

Full-duplex operation over electrical media has been proven both technically and operationally at 25 and 50 Gb/s rates.

Component vendors, including PHY vendors, cabling vendors and systems vendors have presented data on the feasibility of the necessary components for this project. Approaches which leverage existing technologies have been provided.

The reliability of Ethernet components and systems can be projected in the target environments with a high degree of confidence.

Economic Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence of economic feasibility. Demonstrate, as far as can reasonably be estimated, the economic feasibility of the proposed project for its intended applications. Among the areas that may be addressed in the cost for performance analysis are the following:

    a) **Balanced costs (infrastructure versus attached stations).**
    b) **Known cost factors.**
    c) **Consideration of installation costs.**
    d) **Consideration of operational costs (e.g., energy consumption).**
    e) **Other areas, as appropriate.**

Ethernet interfaces in the target data rate range defined by this project will maintain a favorable cost-performance balance.

The balance of costs between infrastructure and attached stations is not applicable to the automotive environment.

The cost factors for Ethernet components and systems are well known. The proposed project may introduce new cost factors which can be quantified.

Prior experience in the development of other physical layer specifications for Ethernet indicates that the specifications developed by this project will entail a reasonable cost for the resulting performance.

The reduction in the number of legacy networks requiring specialized components, expertise, and gateways in the targeted markets will result in a significant drop in both installation and operational costs.

Overall costs are minimized by introducing Ethernet network architecture, management, and software into the automotive environment.

Zonal ~~(centralized)~~ architectures, enabled by greater than 10 Gb/s rates, will allow consolidation of processing resources similar to what has been seen in enterprise networks.

WG Motion

Move that the IEEE 802.3 Working Group approve the IEEE P802.3cy Greater than 10 Gb/s Electrical Automotive Ethernet PHYs CSD "Managed Objects", "Coexistence", "Broad Market Potential", "Compatibility", "Distinct Identity", "Technical Feasibility", and "Economic Feasibility" responses, as per https://mentor.ieee.org/802-ec/dcn/20/ec-20-0009-00-00EC-ieee-p802-3cy-draft-csd-response.pdf with modifications as detailed on slides 13 through 19 of 0520_B10GAUTO_report.pdf.
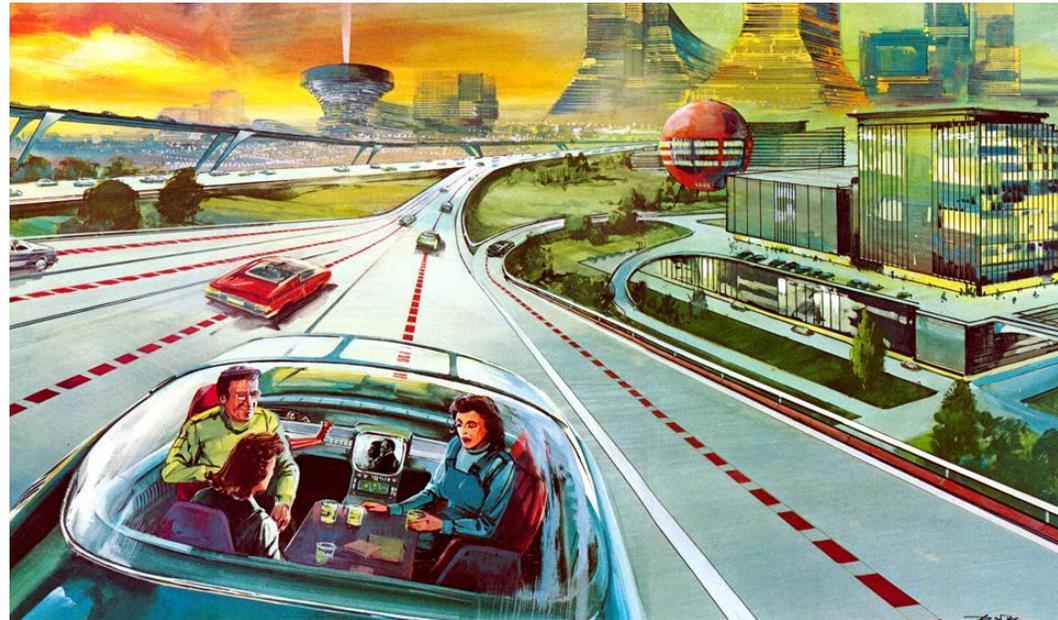
M: George Zimmerman

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Questions?

Thank you!